

R. Alton Gilbert

R. Alton Gilbert is an assistant vice president at the Federal Reserve Bank of St. Louis. Richard I. Jako provided research assistance.

Implications of Netting Arrangements for Bank Risk in Foreign Exchange Transactions

THE MAJOR FINANCIAL institutions of many nations are active participants in the market for foreign exchange. The exchanges of currencies that take place through this market facilitate international trade and the international flow of capital for investments.

The volume of transactions in the foreign exchange market—already very large—has grown rapidly in recent years. As of April 1989, the date of the last international survey, foreign exchange transactions had an average value of \$640 billion per business day.

With dollar amounts in this lofty range, participants in the foreign exchange market could incur substantial losses if the other parties to their transactions were to default on the payments required to settle their side of the trans-

actions. To reduce the costs of transactions and limit the size of these possible losses, some banks engage in bilateral netting of their foreign exchange transactions.¹ In bilateral netting, two banks exchange daily only the net units of currencies in the transactions between them.

Some groups of banks have also studied the possibility of multilateral arrangements for netting foreign exchange transactions, though none are in operation at this time.² Members of a multilateral netting arrangement would settle transactions with each other by making payments to a clearing house for their net position in each currency with the other members.

As part of their responsibility to avoid disruptions in the operation of payment systems, central banks have a strong interest in such netting

¹Netting agreements between pairs of banks may apply to payments in settlement of transactions other than foreign exchange. This paper, however, limits analysis to the netting of foreign exchange transactions. All participants in the foreign exchange market are called banks to simplify exposition. In some markets, the important participants include firms that are not banks. See Federal Reserve Bank

of New York (1989) and Bank of England (1989). See glossary on page 14 for definition of netting and other terms used in this paper.

²See Deeg (1990), Duncan (1991), Luthringhausen (1990) and Polo (1990).

Table 1

Minimum Standards for the Design and Operation of Cross-Border and Multi-Currency Netting and Settlement Schemes

- I. Netting schemes should have a well-founded legal basis under all relevant jurisdictions.
- II. Netting scheme participants should have a clear understanding of the impact of the particular scheme on each of the financial risks affected by the netting process.
- III. Multilateral netting systems should have clearly defined procedures for the management of credit risks and liquidity risks which specify the respective responsibilities of the netting provider and the participants. These procedures should also ensure that all parties have both the incentives and the capabilities to manage and contain each of the risks they bear and that limits are placed on the maximum level of credit exposure that can be produced by each participant.
- IV. Multilateral netting systems should, at a minimum, be capable of ensuring the timely completion of daily settlements in the event of an inability to settle by the participant with the largest single net-debit position.
- V. Multilateral netting systems should have objective and publicly disclosed criteria for admission which permit fair and open access.
- VI. All netting schemes should ensure the operational reliability of technical systems and the availability of back-up facilities capable of completing daily processing requirements.

SOURCE: Bank for International Settlements (1990c).

arrangements.³ Since foreign exchange transactions often involve parties headquartered in different countries, a default by one participant is likely to affect those in other countries. Banks adversely affected by such defaults typically would turn to their central banks for assistance in coping with liquidity problems.

In recent years, promoters of interbank netting arrangements have requested the views of central banks individually on projects that appeared to have implications for a number of countries. The central banks of 10 major industrialized countries recently issued a joint statement, through the Bank for International Settlements, about the netting of foreign exchange transactions. This is commonly called the "Lamfalussy Report," named after the committee chairman who drafted the report. The committee expressed concern about the risks involved in settling foreign exchange transactions and discussed the potential benefits and drawbacks of netting arrangements. The central bankers listed minimum standards for the design of net-

ting arrangements for bankers who may develop them (see table 1).⁴

This paper illustrates the risk in settling foreign exchange transactions and the risk implications of netting, using a hypothetical example of transactions among three banks. This exercise illustrates how netting may reduce risk, if netting arrangements conform to the guidelines in the Lamfalussy Report.⁵

THE MARKET FOR FOREIGN EXCHANGE

A foreign exchange transaction is an agreement by two parties (generally large banks) to exchange currencies on a given date, called the value date of the transaction. The most common type of transaction between participants in the foreign exchange market, a *spot* transaction, is an agreement between two parties to exchange units of currencies two business days from the date the transaction is negotiated. A transaction with a value date more than two days after the

³See Summers (1991) for a discussion of the role of central banks in the operation of payment systems.

⁴Bank for International Settlements (1990c).

⁵Cody (1990) also provides an introduction to the risk in settling foreign exchange transactions and the implications

of netting. See Juncker, Summers and Young (1991) for a general discussion of the issues raised by netting arrangements.

date of negotiation is called a *forward* transaction. Some forward transactions have value dates more than a year into the future, but most call for settlement within a month. Several other types of transactions, including futures contracts, options and swaps, have been developed to more effectively limit the effects of changes in exchange rates on the wealth of banks and their customers.⁶

Large commercial banks are the major participants in the foreign exchange market. The latest international survey of foreign exchange activity, in April 1989, indicates that the three most active centers are London, New York and Tokyo (table 2). The value of foreign exchange transactions has been growing faster than international trade in goods and services (table 3). Such growth reflects more than the growth of international trade; it also reflects international capital flows and transactions by banks and their customers to manage exchange rate risk.

Transactions in the foreign exchange market link the major financial institutions of the world. In the London market, for instance, 80 percent of the value of foreign exchange transactions in April 1989 was by firms with headquarters outside of England.⁷ In the survey of foreign exchange market activity in New York, 40 percent of the value of transactions was reported by offices of foreign banks.⁸ Thus, one of the important ways in which a major financial institution can affect institutions in other countries is by defaulting on foreign exchange transactions.

THE CONFIRMATION AND SETTLEMENT OF FOREIGN EXCHANGE TRANSACTIONS

The process of confirmation and settlement begins after traders at two banks agree on the terms of a transaction. Each bank sends the other a message specifying the terms of the transaction, using a variety of methods, including telephone calls. If the details of the messages match, the transaction is considered confirmed.

The next step depends on the value date of the transaction. If it is a forward transaction, with a value date several weeks or months into the future, the information is stored for future

Table 2

Foreign Exchange Market Activity in April 1989 (billions of U.S. dollars)¹

Countries and items	Value of transactions per day
United Kingdom	\$ 187 ²
United States	129 ²
Japan	115
Switzerland ³ [85%]	57
Singapore	55
Hong Kong	49
Australia	30
France ³ [95%]	26 ²
Canada	15
Netherlands	13 ²
Denmark ³ [90%]	13
Sweden	13
Belgium ³ [90%]	10
Italy ³ [75%]	10
Other countries ⁴	22
Total	744
Adjustment for cross-border double-counting	- 204
Total reported net turnover	540
Estimated gaps in reporting	100
Estimated global turnover	\$ 640

¹Value of transactions in currencies other than U.S. dollar converted to dollars at prevailing exchange rates. The figures for individual countries indicate turnover net of double-counting arising from local interbank business. The totals at the foot of the table are estimates of turnover net of double-counting arising from both local and cross-border interbank business.

²Based on estimates of domestic and cross-border interbank business arranged through brokers.

³No adjustment for less than full coverage; estimated market coverage is given in square brackets.

⁴Bahrain, Finland, Greece, Ireland, Norway, Portugal and Spain.

SOURCE: Bank for International Settlements (1990a).

settlement. On the value date, banks transmit information to initiate payment. The steps to initiate payment depend on the payment system used in the country issuing the currency and the relationship of the paying bank to that pay-

⁶For a more detailed discussion of the foreign exchange market, see Chrystal (1984).

⁷Bank of England (1989).

⁸Federal Reserve Bank of New York (1989).

Table 3

Growth of Foreign Exchange Market Transactions, Foreign Trade and International Banking Activity

Countries	Value of foreign exchange transactions: percentage change between March 1986 to April 1989 net turnover	Exports and imports of goods and services: percentage change from 1/1986 to 1/1989
United Kingdom	108%	62%
United States	120	44
Japan	140	82
Canada	58	44
Total	116	56

SOURCE: Bank for International Settlements (1990a).

ment system. For a bank paying in a currency other than that of its home country, payment generally is made by a correspondent headquartered in the foreign country. A correspondent is a bank that holds deposits and provides services for other banks. The paying bank commonly sends a message over SWIFT, instructing its correspondent to make payment to the counterparty in the foreign exchange transaction.⁹

Suppose, for instance, that a bank headquartered in the United States must pay German marks to a counterparty to settle a foreign exchange transaction. The U.S. bank instructs its German correspondent to make payment to the counterparty (or the counterparty's German correspondent). The German correspondent debits the account of the U.S. bank denominated in marks and transfers the marks to the counterparty. Suppose a U.S. bank is obligated to pay dollars. It would send a message over CHIPS to make payment to the counterparty, either directly if it is a member of CHIPS, or through a correspondent in New York who is a member of CHIPS.¹⁰

THE RISKS INVOLVED IN SETTLING FOREIGN EXCHANGE TRANSACTIONS: AN ILLUSTRATION

Banks assume the risk that their counterparties will default on payments on their side of foreign exchange transactions. Effects on counterparties of default on settlement obligations depend on the financial condition of the bank that defaults. A solvent bank may default for a variety of reasons. Operating problems (for example, computer failure) may prevent them from executing their payment instructions. A solvent counterparty may not have funds in the proper currency on the value date, or simply may forget to send payment orders to settle some of their transactions.

Defaults by solvent banks on settlement obligations may have systemic effects, preventing other banks from settling their obligations. These banks may turn to their central banks for short-term loans denominated in the currency

⁹SWIFT (Society for Worldwide Interbank Financial Telecommunication) is an electronic system, located in Brussels, Belgium, for sending messages among the world's major banks.

¹⁰See Bank for International Settlement (1990b) for a description of payments systems in various countries. CHIPS (Clearing House for Interbank Payments System) is an electronic payments system operated by the New York Clearing House Association. CHIPS participants (131 as of the end of 1990) exchange payment messages during each business day and settle for the net amounts at day-

end with transfers of reserve balances at the Federal Reserve. See Federal Reserve Bank of New York (1991). A large share of CHIPS messages involve payment for the dollar side of foreign exchange transactions. Given that most foreign exchange transactions involve the U.S. dollar, CHIPS has a major role in the settlement of foreign exchange transactions. See Federal Reserve Bank of New York (1987).

Table 4

Payments in Settlement of Foreign Exchange Transactions under Gross Settlement and Bilateral Netting

Counterparties	Transaction number	Gross settlement		Bilateral netting	
		Direction of payment	Units of currencies	Direction of payment	Units of currencies
Bank A and Bank B	1	Bank A to Bank B	£ 100	Bank A to Bank B	£ 50
		Bank B to Bank A	\$175	Bank B to Bank A	\$90
		(Profit of \$10.00 for Bank A)		(Profit of \$7.50 for Bank A)	
	2	Bank A to Bank B	\$85		
Bank A and Bank C	1	Bank B to Bank A	£ 50		
		(Profit of -\$2.50 for Bank A)			
	2	Bank A to Bank C	£ 100	Bank A to Bank C	\$92.50
		Bank C to Bank A	\$170	Bank C to Bank A	£ 50
Bank B and Bank C	1	(Profit of \$5.00 for Bank A)		(Profit of -\$10.00 for Bank A)	
		Bank A to Bank C	\$262.50		
	2	Bank C to Bank A	£ 150		
		(Profit of -\$15.00 for Bank A)			
Bank B and Bank C	1	Bank B to Bank C	£ 150	Bank B to Bank C	£ 100
		Bank C to Bank B	\$262.50	Bank C to Bank B	\$177.50
		(Profit of \$15.00 for Bank B)		(Profit of \$12.50 for Bank B)	
	2	Bank B to Bank C	\$85.00		
		Bank C to Bank B	£ 50		
		(Profit of -\$2.50 for Bank B)			

cies necessary to settle their obligations. Thus, central banks have a collective interest in minimizing the chances of such liquidity problems.

Most liquidity problems are often only temporary. Bankruptcy and liquidation of a participant in the foreign exchange market, however, pose a more serious threat to individual counterparties and create the potential for systemic disruptions in the payment system (default by one bank causing default by others). Under a general definition of bankruptcy, the value of liabilities exceeds the value of assets. Some large bankrupt banks have been reorganized with assistance of their home governments. The reorganized banks continue to operate as going concerns, making payments in settlement of their obligations. Such reorganizations impose no losses on their counterparties.

In other cases, however, bankrupt banks cease to operate as going concerns. The courts appoint receivers to liquidate the bankrupt

banks' assets and make payments to their creditors. The receivers may impose losses on other banks that were counterparties to foreign exchange transactions. Such losses depend on the legal principles followed by bankruptcy courts and the nature of netting agreements between counterparties.

The effects of the liquidation of a participant in the foreign exchange market on its counterparties are illustrated below. Legal assumptions are specified along the way as the example raises questions about the principles followed by bankruptcy courts. In each case in which a bank is assumed to go bankrupt, it is also assumed to be liquidated by a court-appointed receiver.

The Example

Suppose three banks (A, B and C) engage in foreign exchange transactions in two currencies: the U.S. dollar and the British pound. Each bank has foreign exchange transactions with the other two. Table 4 lists the transactions between

the counterparties to be settled on the same value date. Each pair of banks has two transactions to settle. In one transaction, a bank pays dollars in exchange for pounds; in the other, a bank pays pounds in exchange for dollars.

The exchange rate on the value date is \$1.65 per British pound. Transactions to be settled on the value date were negotiated a few days earlier when the exchange rate was higher: some transactions were negotiated with an exchange rate of \$1.70; others, with an exchange rate of \$1.75. Transactions are of varying size, creating imbalances in the flows of currencies between counterparties.

The example is designed to be as simple as possible and yet illustrate the risk involved in netting arrangements. There must be at least two transactions between a pair of banks if bilateral netting is to reduce the volume of payments and settlement risk. Three is the minimum number of banks for multilateral netting.

The Effects of Bilateral Netting on the Number and Value of Transactions

Figure 1 illustrates how bilateral netting affects the flows of currencies between Banks A and B in settling the transactions listed in table 4. Under gross settlement, banks make payments to each other to settle each transaction between them. To settle transaction number 1, Bank A pays £ 100 to Bank B, receiving \$175 in turn. Since the exchange rate is \$1.65 on the value date, this exchange of currencies yields a profit of \$10 to Bank A. (Bank A receives \$175, whereas the £ 100 paid by Bank A has a value of \$165 on the value date). Bank A pays \$85 to Bank B in settlement of transaction number 2, receiving £ 50. This exchange yields a loss of \$2.50 for Bank A on the value date.

Banks A and B can economize on transactions by netting their payments flows. As illustrated in the bottom half of figure 1, Bank A could pay £ 50 to Bank B and receive \$90 from Bank B. Bilateral netting reduces the number of payments from four to two and the value of payments, converted to dollars at the exchange rate of \$1.65, from \$507.50 to \$172.50.

The Risk in Settling Foreign Exchange Transactions without a Netting Arrangement

To illustrate how netting arrangements affect risk, one must first understand the risk that banks assume without a netting agreement.

Legal Assumptions — This section specifies several assumptions about the legal principles that the bankruptcy court follows when banks settle their transactions without netting arrangements. While these principles are not applied in all cases, they are common and they simplify the analysis.

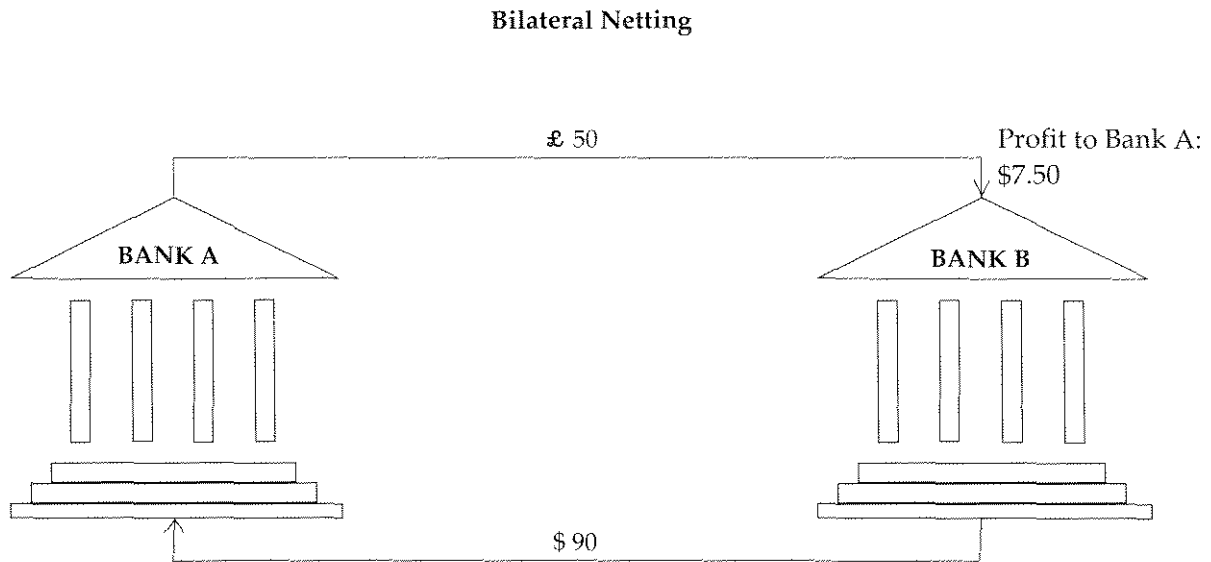
One assumption concerns the application of *legal rights of set-off* permitted by the court. Under the legal rights of set-off, the counterparty of a failed bank may settle its obligations with the receiver by paying the net amount of the transactions between them. If on net the failed bank owes a solvent counterparty, the counterparty is a general creditor of the failed bank for the net amount. Applying the rights of set-off to the foreign exchange transactions between a pair of banks yields the same loss to the solvent counterparty as it would under bilateral netting. Applying the legal rights of set-off, however, is uncertain and varies among the courts of different countries.¹¹ In this paper, rights of set-off are assumed not to apply in bankruptcy. Each transaction is treated separately, not linked to other transactions between the same parties.

The court with jurisdiction in a bankruptcy case is assumed to appoint a receiver. In making payments to settle foreign exchange transactions or defaulting on transactions, the receiver acts to maximize the return to all creditors of the failed bank, without regard for the counterparties to foreign exchange transactions as a particular group of creditors.

A final issue concerns the status of claims against a bankrupt bank that result from its default on foreign exchange transactions. Solvent counterparties are assumed to have the status of general creditors. In our example, losses are calculated under the assumption that general creditors receive nothing. All proceeds from the liquidation of assets go to creditors with more senior claims.

¹¹Bank for International Settlements (1989), pp. 13-14.

Figure 1
Flow of Currencies Between Banks Under Gross Settlement and Bilateral Netting



Number of Payments: 2
Dollar Value: \$172.50

These legal assumptions yield the maximum losses to counterparties. Thus, the losses calculated in particular cases can be viewed as the maximum, not necessarily the most likely, losses.

Timing of Bankruptcy and Size of Exposure

— Suppose Banks A and B agree to settle their transactions as illustrated in the top half of figure 1, the gross settlement method. Suppose also that Bank A goes bankrupt before the four payments are executed on the value date. The possible loss to Bank B depends on the timing of the bankruptcy of Bank A.

In one situation, called *pre-settlement failure*, Bank A goes bankrupt before the value date, and Bank B knows about this event by the opening of business on the value date. In the other situation, called *settlement failure*, a bank makes payment on the value date for its side of foreign exchange transactions but does not receive payment from a counterparty.

One feature of the foreign exchange market that makes banks vulnerable to settlement failure is the difference in the time zones of central banks. The failure of the Herstatt Bank in 1974 illustrates the relationship between time zones and settlement failure. On June 26, 1974, German banking authorities closed Herstatt as of the close of business in Germany. Herstatt had received payment in marks during German banking hours for its foreign exchange transactions with that value date. It was closed, however, before the time for making payments in dollars in New York. Counterparties of Herstatt were left without the dollars they expected, after paying marks to Herstatt earlier in the day.¹²

Our example of settlement failure in this paper reflects the implications of differences in time zones. One bank is assumed to go bankrupt after the time for payments in pounds but before the time for making payments in dollars.

Pre-Settlement Failure — Suppose Bank A goes bankrupt before the value date. Without a netting agreement between Banks A and B, the legal obligations of each bank are those specified in the individual transactions between them. With an exchange rate of \$1.65 on the value date, transaction number 1 is profitable to Bank A. The receiver of Bank A will pay £ 100 to Bank B to settle transaction number 1. Bank B is

obligated to pay \$175 to Bank A to settle this transaction. Since transaction number 2 is not profitable to Bank A on the value date, the receiver will default on transaction number 2. Bank B anticipated a profit of \$2.50 on the value date from transaction number 2. Thus, the bankruptcy of Bank A imposes a loss of \$2.50 on Bank B. Table 5 shows the loss to each bank due to the bankruptcy of its counterparty before the value date, under both gross settlement and netting arrangements.

Settlement Failure — Suppose Bank A goes bankrupt on the value date after payment in pounds but before payment in dollars. Bank A defaults on its payment of \$85 to Bank B on the value date. Under gross settlement of transactions, however, Bank B is obligated to pay the \$175 to Bank A. Bank B becomes a general creditor of Bank A for \$85. The maximum loss to Bank B, as table 6 indicates, is \$85.

Settlement failure can create liquidity problems for the counterparties of a failed bank. Suppose Bank B pays the \$175 to Bank A before discovering that Bank A is bankrupt. The cash balances of Bank B denominated in dollars will be \$85 below the level it had projected for the value date. Bank B might request a discount window loan from the Federal Reserve to cover the \$85 shortfall in its reserve account.

How Bilateral Netting Affects the Losses in Settlement of Foreign Exchange Transactions

If Banks A and B engage in bilateral netting, the effects of the bankruptcy of Bank A on Bank B depend on whether paying the net amount discharges the obligations between counterparties.

Legal Assumptions — Under one type of agreement called *position netting*, two banks agree to net their payments to reduce transactions costs, but the agreement has no effect on their legal obligations. Under the legal assumptions in this paper, the position netting agreement would not prevent the receiver from making payments in settlement of some transactions but defaulting on others with the same counterparty. The bankruptcy court would treat the payment obligation of Banks A and B as though they had no netting agreement. The bankruptcy of one party has the same implica-

¹²Moore (1974).

Table 5

Bank Losses from Pre-Settlement Failure

Failure of	Losses to		
	Bank A	Bank B	Bank C
Bank A			
Gross settlement		\$ 2.50	\$15.00
Bilateral netting		0.00	10.00
Multilateral netting		0.00	2.50
Bank B			
Gross settlement	\$10.00		2.50
Bilateral netting	7.50		0.00
Multilateral netting	0.00		0.00
Bank C			
Gross settlement	5.00	15.00	
Bilateral netting	0.00	12.50	
Multilateral netting	0.00	2.50	

Table 6

Bank Losses from Settlement Failure

Failure of	Losses to		
	Bank A	Bank B	Bank C
Bank A			
Gross settlement		\$ 85.00	\$262.50
Bilateral netting		0.00	92.50
Multilateral netting		0.00	2.50
Bank B			
Gross settlement	\$175.00		85.00
Bilateral netting	90.00		0.00
Multilateral netting	0.00		0.00
Bank C			
Gross settlement	170.00	262.50	
Bilateral netting	0.00	177.50	
Multilateral netting	0.00	85.00	

tions for the counterparty as if they settled transactions using the gross settlement method.

Netting agreements that reduce this exposure to loss mandate that banks discharge their obligations by paying the net amount of the transactions between them. The legal language for such agreements is *netting by novation*. This paper assumes that bankruptcy courts recognize a contract for netting by novation as the only contract between counterparties for settlement of foreign exchange transactions.

A provision of bilateral netting contracts that reduces risk is called *closeout*, which becomes effective when a receiver or liquidator is appointed after a bank declares bankruptcy.¹³ A netting agreement includes a formula that converts all outstanding transactions between a pair of counterparties, for all value dates, into one amount payable immediately. The closeout provision prohibits the receiver of a bankrupt bank from making payments in settlement for transactions with some value dates but defaulting on transactions with other value dates.¹⁴ Bankruptcy courts are assumed to recognize closeout provisions as valid parts of netting arrangements.

Pre-settlement Failure — As the bottom half of figure 1 illustrates, the one contract between Banks A and B under netting by novation calls for Bank A to pay £ 50 and receive \$90. At the exchange rate of \$1.65 on the value date, this contract is profitable for Bank A. Thus, the receiver of Bank A would pay the £ 50 to Bank B to settle the contract. The bankruptcy of Bank A prior to the value date would impose no loss on Bank B, since Bank B had anticipated honoring its contract with Bank A before discovering that Bank A was bankrupt. In each case of pre-settlement failure illustrated in table 5, the losses are smaller under bilateral netting by novation than under gross settlement.

Settlement Failure — The bankruptcy of Bank A after payments in pounds but before payments in dollars imposes no loss on Bank B since, under the netting agreement, Bank A had no obligation to pay dollars to Bank B. As table 6 indicates, in settlement failure, the loss to a bank from the bankruptcy of its counterparty is

¹³Bank for International Settlements (1989), p. 13.

¹⁴One firm that offers legal advice and a communications network for bilateral netting by novation is FXNET. The netting contract drafted by FXNET includes netting by novation and closeout. See Bartko (1990). For further reference to FXNET, see Scarlata (1992), this Review. Plans

for multilateral netting include similar closeout provisions in contracts between individual members and the clearing houses that would act as paying agents for the netting arrangements. See Duncan (1991). These closeout provisions limit the losses of solvent banks resulting from default by counterparties.

smaller under bilateral netting by novation than under gross settlement for each combination of failed bank and counterparty.

The Importance of the Legal Basis for Netting Agreements

The assumptions in this paper concerning the principles that bankruptcy courts follow yield the maximum reductions in losses from netting. These reductions in losses could be smaller under alternative assumptions.

The Lamfalussy Report indicates that bilateral netting could increase risk in settling foreign exchange transactions if netting arrangements do not have a sound legal basis. If netting "obscures the level of exposures, then netting arrangements have the potential to contribute to an increase in systemic risk."¹⁵ The argument that bilateral netting may pose greater risks is based on assumptions about how banks that are active in the foreign exchange market set credit limits with counterparties. Banks with bilateral netting agreements may set credit limits with each other based on their net positions rather than the gross value of the underlying transactions between them. If a bankruptcy court requires payments by a solvent counterparty based on the value of the underlying transactions rather than the netting agreement, the exposure of the solvent counterparty would be larger than expected. This point indicates why the Lamfalussy Report emphasizes the legal basis for netting arrangements (table 1).

Multilateral Netting

Banks may be able to further reduce their transaction costs and their exposure to loss by engaging in multilateral netting. No multilateral netting arrangements are in operation at this time. This section examines the implications of a multilateral netting arrangement modeled after a draft of the plans of the ECHO NETTING system in London.¹⁶

Legal Assumptions — In the contract for multilateral netting, members of a netting arrangement establish a clearing house, which receives and pays out currencies in settlement of foreign exchange transactions. The clearing house is the counterparty for each transaction between members of the multilateral netting arrangement. Each member settles its legal obliga-

tions with the others by making payments to the clearing house. The clearing house assumes responsibility for paying all net amounts due to members, even if a member defaults on its payments to the clearing house.

The contract in a multilateral netting arrangement is assumed to include a closeout provision. If a member of the clearing house goes bankrupt, its receiver has only one decision to make about the foreign exchange transactions that the failed bank negotiated with other members: make the payments to settle the one contract with the clearing house or default.

Payments Flows and Loss Sharing —

Figure 2 presents the payments between members of the netting arrangement and the clearing house, derived from payments that would be made under bilateral netting in table 4. The calculation of the numbers in figure 2 is illustrated for Bank A. Under bilateral netting, Bank A pays the other banks £ 50 (Bank B) and \$92.50 (Bank C) and receives \$90 (Bank B) and £ 50 (Bank C). Under multilateral netting, therefore, Bank A owes the clearing house \$2.50 and the clearing house owes Bank A nothing on the value date. Figure 2 also indicates the payments between the clearing house and Banks B and C.

Any clearing house losses resulting from the default of a member are allocated to the other members in proportion to the losses they would have incurred under bilateral netting. This formula gives each member of the arrangement an incentive to avoid transactions with members it considers to be in danger of going bankrupt.

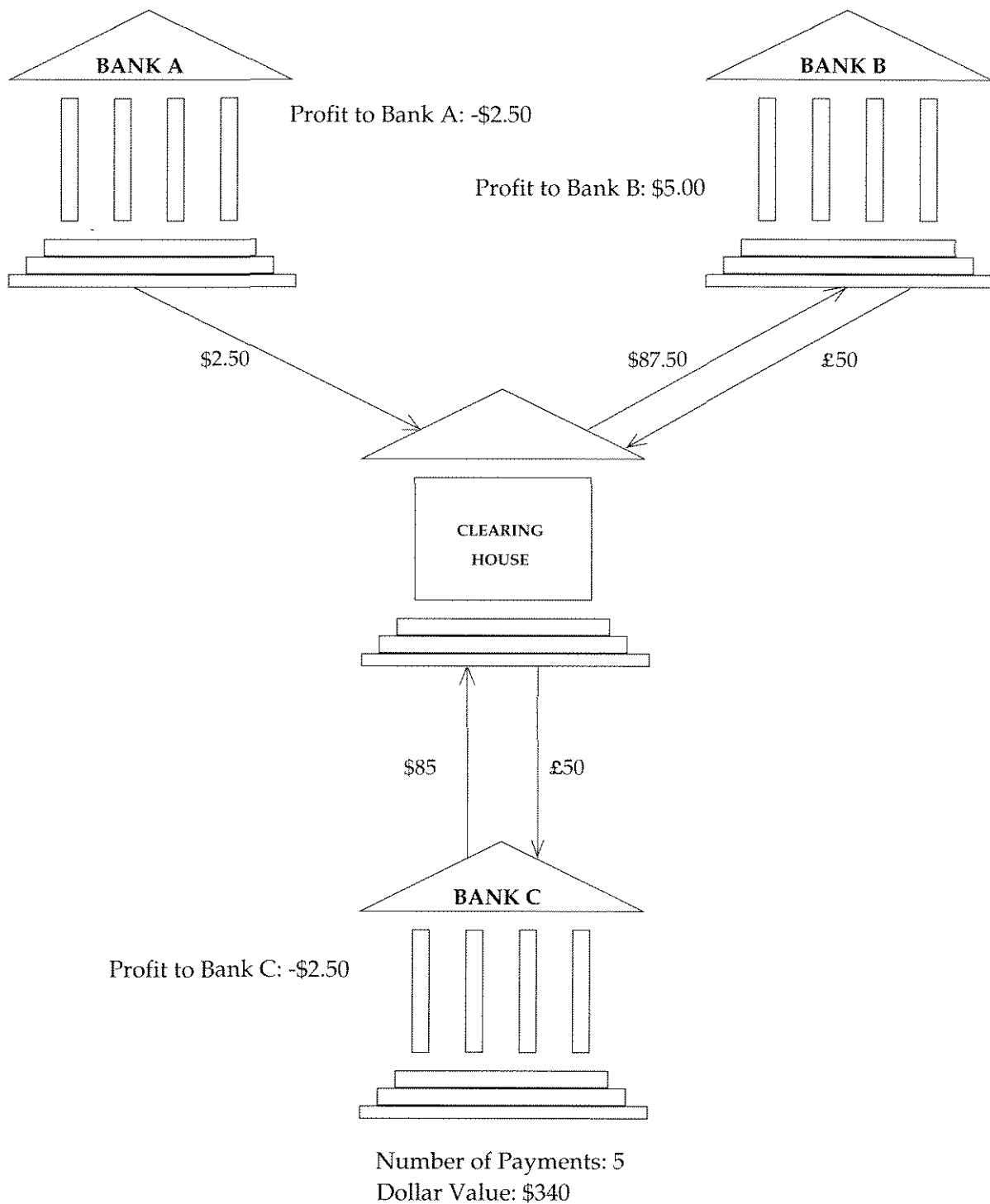
Pre-Settlement Failure — If Bank A goes bankrupt before the value date, its receiver will default on the payment of \$2.50 to the clearing house. The loss of \$2.50 is allocated to Bank C, since only Bank C would have a loss under bilateral netting.

If Bank B goes bankrupt before the value date, its receiver will make the payment of £ 50 to settle the contract with the clearing house, since it yields a profit of \$5 to Bank B. As table 5 indicates, the bankruptcy of Bank B before the value date imposes no loss on the other banks. The bankruptcy of Bank C imposes a loss of \$2.50 on Bank B. In each case in table 5, the

¹⁵Bank for International Settlements (1990c), p. 3.

¹⁶Duncan (1991).

Figure 2

Payments Between Members of a Multilateral Netting Arrangement and the Clearing House

A Glossary of Terms

Bilateral netting	An arrangement between two parties in which they exchange only the net units of the currencies specified in the transactions between them, rather than the currencies for each transaction individually.
Clearing house	An institution established by a group of banks to facilitate the settlement of obligations among themselves. Each bank settles its obligations with the others by making payment to the clearing house for the net amount owed the other members.
Counterparty	The other party in a transaction. In a foreign exchange transaction, one party agrees to make payment in one currency and its counterparty agrees to pay in another currency.
Foreign exchange transaction	An agreement by two parties (generally large banks) to exchange currencies on a given date.
Gross settlement	A method of making payments between a pair of parties in which each party makes a separate payment in settlement of each transaction between them.
Legal rights of set-off	Under bankruptcy law, a right to net obligations with a bankrupt counterparty.
Multilateral netting	An arrangement between three or more parties in which each member makes payments to a clearing house for the net payments due to the other members and receives from the clearing house the net amounts due from the other members.
Netting	An arrangement by which parties with more than one transaction to settle on a given date exchange only the net amounts of the transactions between them.
Netting by novation	The replacement of two existing contracts between two parties for delivery of a specified currency on the same date by a single net contract for that date, so that the original contracts are satisfied and discarded.
Position netting	The netting of payment obligations between two or more parties which neither satisfies nor discharges the original obligations that were netted.
Pre-settlement failure	Bankruptcy of a bank prior to the value date of transactions with a counterparty.
Settlement	Completion of a payment between two parties discharging an obligation.
Settlement failure	Default by a bank on payment in one currency after the bank and its counterparty had made payments in the other currency.
Systemic risk	The risk that the inability of one institution within a payment system to meet its obligations when due will cause other participants to be unable to meet their obligations when due.
Value date	The date on which banks exchange currencies in settlement of a foreign exchange transaction.

loss under multilateral netting is either zero or smaller than under bilateral netting.

Settlement Failure — Suppose Bank A goes bankrupt after the payment of pounds but before the payment of dollars. The loss to be borne by members of the clearing house is \$2.50, the payment obligation of Bank A. This loss is imposed on Bank C, which would have a loss of \$92.50 under bilateral netting (table 6).

Bank B has no obligation to pay dollars to the clearing house. Thus, the bankruptcy of Bank B after the payment of pounds but before the payment of dollars imposes no losses on other members of the clearing house. The bankruptcy of Bank C after payment in pounds imposes a loss of \$85 on Bank B. The loss in each case under multilateral netting in table 6 is either zero or less than the loss under bilateral netting.¹⁷

Liquidity Requirements of the Clearing House

One of the concerns central bankers have about multilateral netting is whether the clearing house would have access to sufficient liquidity to make payments to other members if one of them defaults. The Lamfalussy Report indicates that a clearing house should "be capable of ensuring the timely completion of daily settlements in the event of an inability to settle by the participant with the largest single net-debit position." In figure 2, Banks A and C each have net debit positions of \$2.50. The clearing house would need access to at least \$2.50 to meet the minimum liquidity requirement of the Lamfalussy Report. This requirement is a cost of operating the clearing house, either as the opportunity cost of liquid assets held by the clearing house or the cost of credit lines. Bilateral netting, in contrast, involves no such costs.

CONCLUSIONS

Banks assume risk in settling foreign exchange transactions. This paper examines the implications of netting by using a hypothetical exam-

ple. The example shows how netting schemes can reduce the size of losses to counterparties when a bank goes bankrupt and is liquidated.

A committee of central bankers from the major developed countries recently examined the implications of netting arrangements for risk. The committee's report indicates that netting arrangements may either increase or decrease risk, depending on whether they meet certain minimum standards listed in the report.

Bilateral netting could reduce the loss when a counterparty defaults, if the bankruptcy court would recognize the payment of the net amount between the counterparties as a settlement of the transactions between them. It could increase risk in settlement of foreign exchange transactions, however, if counterparties set credit limits based on their net exposures but the court requires payment in settlement for each underlying transaction between counterparties.

Multilateral netting can reduce the losses resulting from default even more than bilateral netting, if the clearing house created to settle transactions has access to the liquid assets necessary to complete the settlement. Lack of sufficient liquidity for the clearing house could create a major disruption in the operation of the payment system.

REFERENCES

- Bank for International Settlements. *Report on Netting Schemes* (BIS, February 1989).
- _____. *Survey of Foreign Exchange Market Activity* (BIS, February 1990a).
- _____. *Large-Value Funds Transfer Systems in the Group of Ten Countries* (BIS, May 1990b).
- _____. *Report of the Committee on Interbank Netting Schemes of the Central Banks of the Group of Ten Countries* (BIS, November 1990c).
- Bank of England. "The Market in Foreign Exchange in London," *Bank of England Quarterly Bulletin* (November 1989), pp. 531-35.

¹⁷The generality of the result that netting reduces losses to solvent counterparties can be investigated by simulating the losses resulting from default in an example with more banks and more transactions and with some terms of the transactions chosen at random. Our simulation includes 10 banks. Each has 10 transactions to settle with each of the other nine banks. The size of the transactions and exchange rates are chosen at random. The multilateral net-

ting arrangement uses the loss-sharing formula described above. Each of the 10 banks is assumed to go bankrupt, imposing losses on nine counterparties. In each of the 90 cases of losses to counterparties, losses are smaller under bilateral netting than under the gross settlement method, and losses under multilateral netting are either zero or smaller than under bilateral netting.

- Bartko, Peter. "Foreign Exchange and Netting by Novation," *Payment Systems Worldwide* (Spring 1990), pp. 48-51.
- Chrystal, K. Alec. "A Guide to Foreign Exchange Markets," this *Review* (March 1984), pp. 5-18.
- Cody, Brian J. "Reducing the Costs and Risks of Trading Foreign Exchange," Federal Reserve Bank of Philadelphia *Business Review* (November/December 1990), pp. 13-23.
- Deeg, Ernst. "A Proposal for a Multi-Currency Netting System," *Payment Systems Worldwide* (Spring 1990), pp. 40-45.
- Duncan, G. M. "ECHO NETTING: Multilateral FX Netting in Europe," mimeo, Barclays Bank (March 1991).
- Federal Reserve Bank of New York. "A Study of Large-Dollar Flows Through CHIPS and Fedwire," (December 1987).
- _____. "Summary of Results of U.S. Foreign Exchange Market Survey Conducted in April 1989" (September 13, 1989).
- _____. *The Clearing House Interbank Payments System* (January 1991).
- Juncker, George R., Bruce J. Summers and Florence M. Young. "A Primer on the Settlement of Payments in the United States," *Federal Reserve Bulletin* (November 1991), pp. 847-58.
- Luthringshausen, Wayne P. "Characteristics of a Comprehensive Clearing System," *Payment Systems Worldwide* (Spring 1990), pp. 38-39.
- Moore, A. E. "Foreign Exchange," *Bankers' Magazine* (August 1974), pp. 49-51.
- Polo, Renato. "A Perspective on the Euronetting Project," *Payment Systems Worldwide* (Spring 1990), pp. 46-47.
- Scarlata, Jodi G. "Institutional Development in the Globalization of Securities and Futures Markets," this *Review* (January/February 1992), pp. 17-30.
- Summers, Bruce J. "Clearing and Payment Systems: The Role of the Central Bank," *Federal Reserve Bulletin* (February 1991), pp. 81-91.